

(h) Switch the NO<sub>x</sub> generator to the generation mode and adjust the generation rate so that the NO measured on the analyzer is 20 percent of that measured in paragraph (f) of this section. There must be at least 10 percent unreacted NO at this point. Record the concentration of residual NO.

(i) Switch the oxides of nitrogen analyzer to the NO<sub>x</sub> mode and measure total NO<sub>x</sub>. Record this value.

(j) Switch off the NO<sub>x</sub> generator but maintain gas flow through the system. The oxides of nitrogen analyzer will indicate the NO<sub>x</sub> in the NO+O<sub>2</sub> mixture. Record this value.

(k) Turn off the NO<sub>x</sub> generator O<sub>2</sub> (or air) supply. The analyzer will now indicate the NO<sub>x</sub> in the original NO-in-N<sub>2</sub> mixture. This value should be no more than 5 percent above the value indicated in paragraph (f) of this section.

[59 FR 31335, June 17, 1994. Redesignated and amended at 63 FR 56995, 57011, Oct. 23, 1998]

#### § 89.318 Analyzer interference checks.

(a) Gases present in the exhaust other than the one being analyzed can interfere with the reading in several ways. Positive interference occurs in NDIR and PMD instruments when the interfering gas gives the same effect as the gas being measured, but to a lesser degree. Negative interference occurs in NDIR instruments by the interfering gas broadening the absorption band of the measured gas and in CLD instruments by the interfering gas quenching the radiation. The interference checks described in this section are to be made initially and after any major repairs that could affect analyzer performance.

(b) *CO analyzer water and CO<sub>2</sub> interference checks.* Prior to its introduction into service and annually thereafter, the NDIR carbon monoxide analyzer

shall be checked for response to water vapor and CO<sub>2</sub>.

(1) Follow good engineering practices for instrument start-up and operation. Adjust the analyzer to optimize performance on the most sensitive range to be used.

(2) Zero the carbon monoxide analyzer with either zero-grade air or zero-grade nitrogen.

(3) Bubble a mixture of 3 percent CO<sub>2</sub> in N<sub>2</sub> through water at room temperature and record analyzer response.

(4) An analyzer response of more than 1 percent of full scale for ranges above 300 ppm full scale or more than 3 ppm on ranges below 300 ppm full scale requires corrective action. (Use of conditioning columns is one form of corrective action which may be taken.)

(c) *NO<sub>x</sub> analyzer quench check.* The two gases of concern for CLD (and HCLD) analyzers are CO<sub>2</sub> and water vapor. Quench responses to these two gases are proportional to their concentrations and, therefore, require test techniques to determine quench at the highest expected concentrations experienced during testing.

(1) *NO<sub>x</sub> analyzer CO<sub>2</sub> quench check.* A CO<sub>2</sub> span gas having a concentration of 80 percent to 100 percent of full scale of the maximum operating range used during testing shall be passed through the CO<sub>2</sub> NDIR analyzer and the value recorded as *a*. It is diluted approximately 50 percent with NO span gas and then passed through the CO<sub>2</sub> NDIR and CLD (or HCLD), with the CO<sub>2</sub> and NO values recorded as *b* and *c* respectively. The CO<sub>2</sub> shall then be shut off and only the NO span gas passed through the CLD (or HCLD) and the NO value recorded as *d*. Percent CO<sub>2</sub> quench shall be calculated as follows and shall not exceed 3 percent:

$$\% \text{ CO}_2 \text{ quench} = 100 \times \left( 1 - \frac{(c \times a)}{(d \times a) - (d \times b)} \right) \times (a / b)$$

Where:

*a* = Undiluted CO<sub>2</sub> concentration (percent)

*b* = Diluted CO<sub>2</sub> concentration (percent)

*c* = Diluted NO concentration (ppm)

*d* = Undiluted NO concentration (ppm)

(2) *NO<sub>x</sub> analyzer water quench check.*

(i) This check applies to wet measurements only. An NO span gas having a

**§ 89.319**

**40 CFR Ch. I (7–1–11 Edition)**

concentration of 80 to 100 percent of full scale of a normal operating range shall be passed through the CLD (or HCLD) and the response recorded as D. The NO span gas shall then be bubbled through water at room temperature and passed through the CLD (or HCLD) and the analyzer response recorded as AR. Determine and record the bubbler absolute operating pressure and the bubbler water temperature. (It is important that the NO span gas contains minimal NO<sub>2</sub> concentration for this check. No allowance for absorption of NO<sub>2</sub> in water has been made in the following quench calculations. This test may be optionally run in the NO mode to minimize the effect of any NO<sub>2</sub> in the NO span gas.)

(ii) Calculations for water quench must consider dilution of the NO span gas with water vapor and scaling of the water vapor concentration of the mixture to that expected during testing. Determine the mixture's saturated vapor pressure (designated as *Pwb*) that corresponds to the bubbler water temperature. Calculate the water concentration (*Z1*, percent) in the mixture by the following equation:

$$Z1 = 100 \times \frac{Pwb}{GP}$$

where

GP = analyzer operating pressure (Pa)

(iii) Calculate the expected dilute NO span gas and water vapor mixture concentration (designated as *D1*) by the following equation:

$$D1 = D \times \left( 1 - \frac{Z1}{100} \right)$$

(iv)(A) The maximum raw or dilute exhaust water vapor concentration expected during testing (designated as *Wm*) can be estimated from the CO<sub>2</sub> span gas (or as defined in the equation in this paragraph and designated as *A*) criteria in paragraph (c)(1) of this section and the assumption of a fuel atom H/C ratio of 1.8:1 as:

$$Wm(\%) = 0.9 \times A(\%)$$

Where:

*A* = maximum CO<sub>2</sub> concentration expected in the sample system during testing.

(B) Percent water quench shall not exceed 3 percent and shall be calculated by:

$$\% \text{Water Quench} = 100 \times \frac{D1 - AR}{D1} \times \frac{Wm}{Z1}$$

[59 FR 31335, June 17, 1994. Redesignated and amended at 63 FR 56995, 57011, Oct. 23, 1998; 63 FR 58101, Oct. 29, 1998]

**§ 89.319 Hydrocarbon analyzer calibration.**

(a) The FID hydrocarbon analyzer shall receive the initial and periodic calibration as described in this section. The HFID used with petroleum-fueled diesel (compression-ignition) engines shall be operated to a set point  $\pm 5.5$  °C between 185 and 197 °C.

(b) *Initial and periodic optimization of detector response.* Prior to introduction into service and at least annually thereafter, adjust the FID hydrocarbon analyzer for optimum hydrocarbon response as specified in this paragraph. Alternate methods yielding equivalent

results may be used, if approved in advance by the Administrator.

(1) Follow good engineering practices for initial instrument start-up and basic operating adjustment using the appropriate fuel (see § 89.312(e)) and zero-grade air.

(2) Optimize the FID's response on the most common operating range. The response is to be optimized with respect to fuel pressure or flow. Efforts shall be made to minimize response variations to different hydrocarbon species that are expected to be in the exhaust. Good engineering judgment is